Posteroinferior Cerebellar Artery Aneurysms: Surgical Results for 38 Patients

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All patients who were surgically treated at The University of Texas Southwestern Medical Center’s Zale-Lipshy Univtheir charts retrospectively reviewed for the period of January 1990 to May 1997. Data were collected concerning patieAmerican Society of Anesthesiologists (ASA) classification, timing of surgery, existence of multiple aneurysms, aneurysnand brain resection, and postoperative neurological complications. Patient condition and outcome (Glasgow Outcome S and at 6 and 12 months after discharge. Patients treated at Parkland Memorial Hospital by the same group of surgen's data accrual.

Surgical procedure

PICA aneurysms located along the anterior and lateral medullary segments are approached using a lateral suboccip described by Ojemann et al. (10) and Samson and Batjer (13), with minor modifications. The first of these is our incisio exposure (Fig. 1). Second, we routinely remove the lateral foramen magnum and expose the vertebral artery extradura before the dural opening. We do not routinely remove the ring of C1. We think aggressive lateral drilling is necessary to necessity for drilling into the lateral occipital condyle to maximize exposure of the proximal intradural vertebral artery intradural vertebral artery is located immediately medial to Cranial Nerve XI. Sharp dissection along the vertebral artery located. The PICA origin is then found near the origin of Cranial Nerve XII. After proximal and distal control has been ac dissection and is ultimately clipped. Liberal use of temporary occlusion of the vertebral artery and/or PICA permits sha aneurysm rupture. We try to limit periods of temporary occlusion to 20 minutes or less.
FIGURE 1. Scalp (A), muscle (B), and bone (C) openings used for exposure of PICA aneurysms.
Distal aneurysms involving the telovelotonsilar and cortical PICA segments are approached with the patient in a prone position. Routine microdissection and clipping is then performed.

RESULTS

Cases evaluated
Between January 1990 and May 1997, 42 patients presented with a diagnosis of PICA aneurysm. Thirty-eight of these Guglielmi detachable coils, and one was managed with coil sacrifice of the PICA. The 38 surgical patients are evaluated

Demographics

Distribution by sex was skewed, with 84% (n = 32) of the patients being female and 16% (n = 6) being male. No patient was aged between the ages of 40 and 70 years.

Patient clinical characteristics

Without adjusting for other medical illnesses, 26% (n = 10) of the patients presented with Hunt and Hess Grade 0, 3 (n = 12) with Grade III, 5% (n = 2) with Grade IV, and 0% with Grade V.

Of the 28 patients presenting with subarachnoid hemorrhage (SAH), 25 had initial computed tomographic results revealing intraventricular blood and were thus characterized as Fisher Grade 4, 24% (n = 6) as Grade 3, and 8% (n = 2) as Grade 1. Moderately ill. Five percent (n = 2) had an ASA classification of 2, 58% (n = 22) had an ASA classification of 3, 34% (n = 11) had an ASA classification of 5. No patients had ASA classifications of 1 or 6.

When aneurysm size and mode of presentation were analyzed, 17% (n = 5) of these lesions less than 1 cm in diameter presented with symptoms that were possibly related to the aneurysm (ataxia). Larger lesions were more likely to present before rupture to 2.5 cm in diameter presented with symptoms, whereas 75% of the giant lesions presented with symptoms. Although this is a significant result, we were not able to make any statistical statements.

Aneurysm characteristics

Eighty-four percent (n = 32) of our patients had only one aneurysm each, whereas 16% (n = 6) had multiple lesions. Twenty-five percent (n = 8) were located at the PICA origin, 5% (n = 2) at the choroidal point, and 16% (n = 6) along the distal vessel. Twenty-nine percent (n = 8) were left-sided lesions. Seventy-nine percent (n = 30) of the lesions were less than 1 cm in diameter, 11% (n = 4) were<br />

Operative procedure characteristics

Of the 28 ruptured lesions, 39% (n = 11) were treated within 2 days of hemorrhage, 29% (n = 8) within 2 to 5 days, and treatment was generally delayed referral. One patient’s surgical timing could not be ascertained. All proximal aneurysm approach with extradural vertebral artery isolated along the ring of C1 in the majority of cases. More distal lesions midline suboccipital approach. Using this procedure, 97% (n = 37) of the patients each required a single operation. One uncontrollable venous bleeding before the dural opening at the time of the first procedure. Eight percent (n = 3) of the complications. One of the complications was the above mentioned venous bleeding. The other two complications were patients who suffered intraoperative aneurysm ruptures were classified as Hunt and Hess Grade III and had a GOS score of 1 at 6 months after discharge, and the other had a GOS score of 2 at 1 year after discharge. Cerebellar resection for tonsillar resection was necessitated by iatrogenic contusion, one episode of partial cerebellar hemisphere resection occurred the third episode was for exposure of an aneurysm embedded within the vermis. Intraoperative temporary arterial occlusion exact duration was difficult to accurately determine from this review. Ninety-five percent (n = 36) of the aneurysms we required aneurysm resection and end-to-end PICA anastomoses. The duration of surgery varied, with 18% (n = 7) of the
181 to 240 minutes, and 32% (n = 12) taking longer than 240 minutes. Despite exposure of large venous structures (sinus plexus, 55% (n = 21) of the patients lost less than 500 ml of blood and 21% (n = 8) lost 501 to 1000 ml.

Complications and outcomes

Sixty-six percent (n = 25) of the patients developed new postoperative neurological deficits representing neurological 1), 3% (n = 1) facial paralysis secondary to facial nerve transection in association with a giant aneurysm clipping, 47% tr evaluation (n = 18), 24% tracheostomy (n = 9), 37% dysphagia (n = 14), 11% shunted hydrocephalus (n = 4), 21% gastrost ataxia (n = 20), 3% new extremity weakness (n = 1), and 5% symptomatic vasospasm (n = 2). One patient died (3%) durin hemorrhaged. As stated above, 25 patients (66%) had at least one postoperative neurological complication each. When one complication each, 32% (n = 8) had two complications each, and 24% (n = 6) had three or more complications each.

When analyzed according to aneurysm size, 69% (n = 20) of the patients with lesions less than 1 cm in diameter dev complication each, whereas 50% (n = 2) of the patients with aneurysms that were 1 to 2.5 cm in diameter and 75% (n = than 2.5 cm in diameter did so. The patients with distal aneurysms had a 50% (n = 3) incidence of ataxia after surgery. 1 cm, 1 to 2.5 cm, and greater than 2.5 cm in diameter had a 33% (n = 1), 50% (n = 2), and 66% (n = 2) incidence, i complications. The numbers are too small to make a statistical evaluation.

At the 1-year follow-up examination, many of the above problems remained but many had also resolved. No patien Seventy-one percent of the discharge dysphagic group was available for follow-up (n = 10). Of these, four remained dys follow-up, 40% of those dysphagics at discharge who were available for follow-up). Eighty-six percent of those with dipl Of these, three continued to have diplopia (8% of entire PICA population available for follow-up, 50% of those with dipl Eighty percent of those with ataxia at discharge were available for follow-up (n = 16). Of these, seven remained unstea up, 44% of those with ataxia at discharge who were available for follow-up).

An attempt was made to follow all patients in our vascular clinic to chart their recovery. GOS scores (1 = good rec disability, disabled but independent; 3 = severe disability, conscious but dependent; 4 = persistent vegetative state, un at the time of discharge for 100% of the patients (n = 38), at 6 months after discharge for 92% (n = 35), and at 1 year af

<table>
<thead>
<tr>
<th>GOS Score of 1 (%)</th>
<th>GOS Score of 2 (%)</th>
<th>GOS Score of 3 (%)</th>
<th>GOS Score of 4 (%)</th>
<th>GOS Score of 5 (%)</th>
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<tbody>
<tr>
<td>Discharge</td>
<td>14 (37)</td>
<td>14 (37)</td>
<td>8 (21)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>6 mo</td>
<td>23 (66)</td>
<td>9 (26)</td>
<td>1 (3)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1 yr</td>
<td>14 (52)</td>
<td>10 (37)</td>
<td>1 (4)</td>
<td>0 (0)</td>
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</tbody>
</table>

*GOS, Glasgow Outcome Scale. Discharge group, n = 38; 100% follow-up. Six-month group, n = 35; 92% follow-up. One-year group, n = 27; 84% follow-up of 32 patients treated between 1990 and 1996.

*One patient died as the result of unknown causes.

*Patients treated during 1997 were not yet available for 1-year follow-up.

**TABLE 1. Glasgow Outcome Scale Scores in Surgical Group**

At the time of discharge, 74% (n = 28) of the patients were independent (GOS score of 1 or 2). At 6 months after di independent, and at 1 year after discharge, 89% (n = 24) of those followed were independent. This reduction in percent number of patients available for follow-up (92% at 6 mo and 84% at 1 yr). Although 16% (n = 5) were severely disabled ( had been reduced to 3 to 4% (n = 1) at 6 and 12 months after discharge (of those followed). Two patients were vegetati death was recorded at 6 months to have resulted from unknown causes.
Table 2 shows the GOS scores at the time of discharge and at 6 months after discharge as they related to the Hunt comparison, once again, demonstrates that the severity of the Hunt and Hess grades at the time of presentation correlate.

<table>
<thead>
<tr>
<th>Hunt and Hess Grade</th>
<th>Discharge (n = 38)</th>
<th>6 mo (n = 35)</th>
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<tbody>
<tr>
<td></td>
<td>1 &amp; 2</td>
<td>3</td>
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<tr>
<td>0 (n = 6)</td>
<td>5 (50)</td>
<td>2 (20)</td>
</tr>
<tr>
<td>1 (n = 12)</td>
<td>1 (100)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>2 (n = 11)</td>
<td>3 (25)</td>
<td>4 (33)</td>
</tr>
<tr>
<td>3 (n = 4)</td>
<td>1 (50)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>5 (n = 0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
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</tbody>
</table>

* Three patients were lost to follow-up at 6 months after discharge. Patient 1, Hunt and Hess Grade II and discharge GOS score of 2. Patient 2, Hunt and Hess Grade I and discharge GOS score of 1. Patient 3, Hunt and Hess Grade 0 and discharge GOS score of 3.

TABLE 2. Hunt and Hess Grade versus Glasgow Outcome Scale Score at the Time of Discharge and at Six Months after Discharge

**DISCUSSION**

**Anatomy**

The PICA originates from the vertebral artery at the anterolateral aspect of the medulla at the level of the inferior Cranial Nerve XII and then Cranial Nerves IX and X. The vessel has traditionally been divided into segments based on its first is the anterior medullary segment, which includes the area from the PICA origin to an imaginary line traveling the lateral medullary segment, which extends from the olive to the origins of Cranial Nerves IX, X, and XI. The tonsillar XI to the caudal portion of the tonsil, and the telovelotonsilar segment includes the segment beginning at the midportia tonsil and ending where it exits the fissures between the vermis, tonsil, and hemisphere. The final cortical segment incerebellar surface. Along the PICA's course, a variety of branches arise. These include brain stem perforators from the tonsillomedullary segment has the most choroidal vessels that arise from the tonsillomedullary and telovelotonsilar segments vermian branches that arise from the medial cortical segment and hemispheric/tonsilar branches that arise from the lateral PICA are shown in Figure 3.
Literature review

PICA aneurysms are rare. The review presented by McDonald and Korb (9) of published aneurysm cases in 1939 reported a 0.49% incidence. A number of other reviews and reports have been published (1-4,14), the largest of 146 cases.

A review of the available English literature reveals that analysis of clinical results related to PICA aneurysm treatment can be discussed below to place the results of this current series in perspective.

Yamamoto et al. (14) reported outcomes for 37 patients by simply grading outcomes as excellent, satisfactory, good, and those factors that may have contributed to these results.

Gacs et al. (3) reported outcomes of 11 aneurysms as excellent, good, or dead but did not analyze other patient data; they simply stated whether the patients had recovered or died.

Peerless and Drake (11) analyzed their results in 146 cases by comparing preoperative Hunt and Hess grades to outcomes. Their findings clearly indicated that patients who were in better neurological condition at the time of presentation and
than did patients who presented in poor condition. Ninety-four percent of the patients with small aneurysms had ‘good’ patients (11). Our data supports this finding with patients of Grade III or greater having worse outcomes at the time of

Andoh et al. (1) analyzed 42 PICA cases and commented mainly on the incidence of postoperative Cranial Nerve IX (6) described 14 PICA aneurysms, 10 of which were located at the vessel origin. Outcomes for all 14 lesions were listed dysphagia, and 7% vocal cord paralysis requiring a tracheostomy. Of those patients presenting with Hunt and Hess Grade II, 66% returned to full activity and 33% died. Thirty-three percent of Hunt and Hess Grade III patients returned to full activity (6).

Salcman et al. (12) studied 13 PICA aneurysms, 10 of which were at the PICA origin. Outcomes in this article were confluent aneurysms combined. As a result of this reporting method, the reader cannot glean the true incidence of PIC.

Yamaura (15) reported 90 PICA aneurysms, 77 of which involved the PICA origin. No specific data were provided co statement that three patients developed Cranial Nerve VI palsy and eight patients developed Cranial Nerve IX and X pals remarkable. All lower cranial nerve deficits improved in days to weeks, except in one patient, who had a persistent ho

Yasargil (16) described 15 PICA aneurysms, 10 of which were at the vessel origin. No specifics relating to outcome good outcomes and 1 had a fair outcome. Ishikawa et al. (5) reported 12 distal PICA aneurysms with no clear discussion.

The most comprehensive review to date was that presented by Hudgins et al. (4) in their report of 21 PICA aneurysm Hunt and Hess Grade I, 38% were Grade II, and 19% were Grade III. As with the report presented by Peerless and Drake greater incidence of adverse outcomes. Sixty-six percent of Grade I patients were normal at the time of discharge, who were without deficits. The overall results included a 14% incidence of hydrocephalus, 14% hemiparesis (10% postoperat Wallenberg’s syndrome, and 10% death. In terms of outcome, 62% of the patients returned to all previous activities, 19% lifestyles, 10% had disabling deficits, and 10% died. One death resulted secondary to SAH from a different aneurysm the study, however, did not provide specifics in terms of resolution of various symptoms during the convalescent period.

Present study

Our surgical results for 38 patients with PICA aneurysms clearly indicated that these lesions were not benign and evaluated at 6 months after discharge (94% follow-up) being independent. Although 66% of the patients had new postop achieved significant recoveries. Nevertheless, 37% had persistent problems at 1 year after discharge. If we consider the 11% had some degree of deficit at 6 months after discharge (n = 8). Of those who presented with SAH, 46% were normal moderate deficits (n = 1), 0% had severe deficits, and 6% were dead (n = 2) at 6 months after discharge. Higher GOS score after discharge seemed to be associated with the presence of hydrocephalus and clinical vasospasm. Because of the rel could detect no firm correlations between Fisher grade and outcome. The severity of the Hunt and Hess grades at the score at the time of discharge and at 6 months after discharge (Table 2), although statistical significance could not be incomplete follow-up.

Many of the morbidities we observed were related to lower cranial nerve dysfunction. Our approach to PICA aneurysm vector. This approach forces the surgeon to work through the lower cranial nerves in a dorsal-to-ventral direction (mos
beneath them. It is possible that by removing the ring of C1 and working more along the axis of the brain stem with the PICA aneurysms could be approached from the ventral side of the nerves, thus reducing the need for excessive cranial resection.

Despite perceived advances in neuroanesthesia, neuroimaging, and surgical techniques, our results closely parallel those reported by others. However, our overall results show that considerable improvements in a patient's neurological condition can occur postoperatively and that better postoperative results are possible. The overall results should not discourage neurosurgeons from treating PICA aneurysms. In time that surgical clipping carries risk, many of which are temporary, of post-operative neurological dysfunction.

REFERENCES


Key words: Aneurysm; Outcome; PICA

IMAGE GALLERY

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